FOREST AND RANGE SOILS RESEARCH IN OREGON AND WASHINGTON

a bibliography with abstracts from 1964 through 1968

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
DEPARTMENT OF AGRICULTURE · PORTLAND, OREGON
FOREST SERVICE RESEARCH PAPER PNW-90 · 1969

FOREWORD

The purpose of this paper is to reference and briefly summarize all published forest and range soils research done in Oregon and Washington for the past 5 years--1964 to 1968. This paper supplements USDA Forest Service Research Paper PNW-15 published October 1964 showing earlier forest soils research publications. There are some earlier publications listed, as range soils research and theses titles are included for the first time.

The growth of forest and range soils research within Oregon and Washington is quite evident in this paper. In Research Paper PNW-15, 139 publications from the years 1914 through 1963 were listed. In the present paper, 115 new publications are listed for the past 5 years. The talent going into forest and range soils research is emphasized by the 80 theses titles given in this paper.

We have again attempted in the abstracts to accurately brief major findings or the theme of each reference. This condensed information is intended only to lead the reader to the original publication.[1] A subject matter index is also provided.

An active file of Oregon and Washington forest and range soils research publications is maintained by the author. He would appreciate being notified of any omissions.

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[1] Publications listed herein are not available from the Pacific Northwest Forest and Range Experiment Station unless issued by the organization. Requests for reprints should be addressed to the author cited.

USDA FOREST SERVICE
RESEARCH PAPER PNW-90

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1969

PACIFIC NORTHWEST

FOREST AND RANGE EXPERIMENT STATION

Philip A. Briegleb, Director

Portland, Oregon

BIBLIOGRAPHY

1. Alban, D. H.
1967. Soil characteristics related to the presence of individual western hemlock and western redcedar trees. Amer. Soc. Agron. Abstr., p. 131.

Soil differences under hemlock and cedar were reflected in the composition of the foliage and surface litter for Ca and pH, but not for N, C, Mg, or K.

2. Anderson, E. William.
1956. Some soil-plant relationships in eastern Oregon. J. Range Manage. 9: 171-175, illus.

From a study of range sites, their soils, original vegetation, and response to grazing use, some significant soil-plant relationships are given.

3. ____________________
1962. Behavior of forage yields on some range sites in Oregon. J. Range Manage. 15: 245-252, illus.

Discusses some fundamental yield-site-soil relationships that exist on rangelands of eastern Oregon.

4. ____________________
1968. Soil information for range resource evaluation. J. Range Manage. 21: 406-409, illus.

Discusses the flexibility needed in designing soil mapping units to meet the needs of the range manager.

5. ____________________ and Poulton, C. E.
1958. Collection of ecological data for soil-site correlation in Oregon. U.S. Soil Conserv. Serv. and Oreg. State Univ. Joint Publication, 17 pp.

6. Anderson, Henry W., and Gessel, Stanley P.
1966. Effects of nursery fertilization on outplanted Douglas-fir. J. Forest. 64: 109-112, illus.

Application of 50 pounds per acre nitrogen in the nursery late in the growing season significantly increased field survival. Fertilized trees grew faster and were taller than unfertilized trees at the end of 5 years.

7. Babalola, O., Boersma, L., and Youngberg, C. T.
1968. Photosynthesis and transpiration of Monterey pine seedlings as a function of soil water suction and soil temperature. Plant Physiol. 43(4): 515-521, illus.

Photosynthesis, respiration, and transpiration rates of Monterey pine were found to decrease with decreasing soil water content and decreasing soil temperature.

8. Balci, A. N.
1968. Soil erosion in relation to properties of eastern and western Washington forest soils. Soil Sci. Soc. Amer. Proc. 32: 430-432.

Soil erodibility and related properties of forest soils sampled from similar parent materials were compared and real differences found.

9. Barrett, James W., and Youngberg, C. T.
1965. Effect of tree spacing and understory vegetation on water use in a pumice soil. Soil Sci. Soc. Amer. Proc. 29: 472-475, illus.

Water use in a pumice soil in central Oregon increased significantly with increased density of a sapling ponderosa pine (*Pinus ponderosa* Laws.) stand.

10. Bollen, Walter B., Chen, Chi-Sin, Lu, Kuo C., and Tarrant, Robert F.
1967. Influence of red alder on fertility of a forest soil--microbial and chemical effects. Oreg. State Univ., Forest Res. Lab. Res. Bull. 12, 61 pp., illus.

Microbial and chemical characteristics of soil under stands of alder, conifer, and mixtures of both were determined at seasonal intervals. Total nitrogen was always higher under alder and the mixed stand than beneath conifers. *Streptomyces,* most prominent under the mixed stands, produce antibiotics which may inhibit fungal pathogens that attack roots of conifers.

11. Bollen, W. B., Chen, C. S., Lu, K. C., and Tarrant, Robert F.
1968. Effect of stemflow precipitation on chemical and microbiological soil properties beneath a single alder tree. *In* Biology of alder, J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen (eds.), Northwest Sci.Ass. Fortieth Annu. Meet. Symp. Proc. 1967, pp. 149-156.

Stemflow from a single alder tree had greater concentrations of nitrogen and dissolved solids than throughfall of gross precipitation but did not influence chemical or microbial soil properties at a distance of only 2 feet from the stem.

12. ___________ and Lu, K. C.
1968. Nitrogen transformations in soils beneath red alder and conifers. *In* Biology of alder, J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen (eds.), Northwest Sci. Ass. Fortieth Annu. Meet., Symp. Proc. 1967, pp. 141-148.

Nitrogen transformations, particularly nitrification, are rapid in soils under coastal Oregon stands of red alder, conifers (Douglas-fir, western hemlock, and Sitka spruce), and mixed stands of alder and conifers. Nitrification is especially rapid in the F layer beneath alder stands despite a very low hydrogen-ion concentration.

13. Borchardt, G. A., Theisen, A. A., and Harward, M. E.
1968. Vesicular pores of pumice by mercury intrusion. Soil Sci. Soc. Amer. Proc. 32: 735-737, illus.

Destructive vesicular pore size distribution curves were obtained for pumice materials from Mount Mazama, Glacier Peak, and Newberry Crater.

14. Chichester, F. W., Youngberg, C. T., and Harward, M. E.
1969. Clay mineralogy of soils formed on Mazama pumice. Soil Sci. Soc. Amer. Proc. 33: 115-120.

Samples of the clay fraction in central Oregon pumice were found to have mineral sites consisting predominantly of X-ray amorphous material in combination with a rather complex group of 2:1 phyllosilicates, gibbsite, feldspars, and quartz. Physical and chemical analyses are given for several Mazama pumice soils.

15. Cochran, P. H.
1968. Can thinning slash cause a nitrogen deficiency in pumice soils of central Oregon? Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-82, 11 pp.

Decomposition of thinning slash deposited on the soil surface and decomposition of roots of cut trees should not adversely affect soil nitrogen available to the remaining trees in the pumice soil region. Incorporation of chipped slash into the soil might cause a temporary nitrogen deficiency which could be prevented by fertilization.

16. ____________ Boersma, L., and Youngberg, C. T.
1967. Thermal properties of a pumice soil. Soil Sci. Soc. Amer. Proc. 31: 454-459, illus.

Calculated thermal conductivities of Mount Mazama dacite pumice materials were compared with experimentally measured conductivities and found to be in good agreement. The very low thermal conductivity values found may account for the frequent occurrence of light frost in pumice soils.

17. Cole, D. W.
1967. The forest soil--retention and flow of water. Soc. Amer. Forest. Proc. 1966: 150-154, illus.

The theory of retention and flow of soil water along with experimentally determined values for a forest soil is presented.

18. _________ and Gessel, S. P.
1968. Cedar River research; a program for studying the pathways, rates, and processes of elemental cycling in a forest ecosystem. Inst. Forest Prod. Forest Resources Monogr. 4, 54 pp.

19. _________ and Gessel, Stanley P.
1965. Movement of elements through a forest soil as influenced by tree removal and fertilizer additions. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 95-104, illus.

Only small amounts of N, P, K, and Ca were removed by leaching beyond the effective rooting depth over a 10-month period. Most leaching occurred during the fall and early winter.

20. Cole, Dale W.
1968. A system for measuring conductivity, acidity, and rate of water flow in a forest soil. Water Resources Res. 4: 1127-1136.

An integrated system has been developed for collecting, recording, and analyzing data describing the behavior of water flowing through a forest soil.

21. Corliss, J. F., and Dyrness, C. T.
1965. A detailed soil-vegetation survey of the Alsea Area in the Oregon Coast Range. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 457-483, illus.

This soil-vegetation survey is not only an inventory of the two resources but includes descriptions of the relationships and lists use limitations. It provides land managers with information for evaluating land use alternatives, recognizing potential problems, and formulating management plans.

22. Czamanske, Gerald K., and Porter, Stephen C.
1965. Titanium dioxide in pyroclastic layers from volcanos in the Cascade Range. Science 150: 1022-1025, illus.

Widespread layers of volcanic ash from Glacier Peak and Mount Mazama have characteristic ranges of TiO_2 content that are of value in differentiating the two.

23. De Backer, L. W., and Boersma, L.
1967. Water movement in small forest covered plots. Oreg. State Univ., Water Resources Res. Inst. Progr. Rep.

Methods of measuring and analyzing the water budget in soils under stands of Douglas-fir and oak are presented.

24. Driscoll, Richard S.
1964. Vegetation-soil units in the central Oregon juniper zone. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Pap. PNW-19, 60 pp., illus.

A detailed description of vegetation and soil characteristics of the central Oregon juniper zone is presented, including a key to its plant associations and application of the findings to range and wildlife habitat management.

25. Dyrness, C. T.
1965. Soil surface condition following tractor and high-lead logging in the Oregon Cascades. J. Forest. 63: 272-275, illus.

Runoff and erosion from tractor logging and compaction are minimized if slopes do not exceed 20 to 30 percent and skidroads are located on the contour.

26. ______
1966. Erodibility and erosion potential of forest watersheds. Int. Symp. Forest Hydrol., Nat. Sci. Found. Advanced Sci. Seminar Proc. 1965: 599-611.

Discusses factors affecting forest soil erodibility; the influence of fire, logging, and road construction on measured amounts of erosion and soil erodibility characteristics; and research needs in this field.

27. ______
1966. Soil-vegetation relationships within the ponderosa pine type in the central Oregon pumice region. Ecology 47: 122-138, illus.

Six plant communities were identified and characterized. Soils are regosols developed on Aeolian pumice deposits. Soil morphology, moisture depletion rate, and fertility were related to plant community occurrence.

28. ______
1967. Mass soil movements in the H. J. Andrews Experimental Forest. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Pap. PNW-42, 12 pp., illus.

A study of 47 mass movement events, resulting from severe storms during the winter of 1964-65, found that 72 percent were connected with road construction and the great majority occurred in soils derived from pyroclastic parent materials.

29. ______
1967. Soil surface conditions following skyline logging. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-55, 8 pp.

A study on the west side of the Cascade Range in Oregon indicated very little difference in yarding-caused soil disturbance between skyline and high-lead logging methods. The main advantage of skyline yarding is that it requires far less road construction than other logging methods.

30. ______
1967. Grass-legume mixtures for roadside soil stabilization. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-71, 19 pp., illus.

Field evaluation of legumes indicated that big trefoil, white Dutch clover, New Zealand white clover, and birdsfoot trefoil grow moderately well on subsoil sites in central Oregon coast ranges and at low elevations in western Cascades. Erosion plot experiments at a typical backslope site in H. J. Andrews Experimental Forest showed four grass-legume seeding mixtures and a straw mulch-fertilizer treatment were equally effective in curtailing soil movement. Bare controls were the only plots showing significant erosion.

31. Franklin, Jerry F., and Pechanec, Anna A.
1968. Comparison of vegetation in adjacent alder, conifer, and mixed alder-conifer communities. I. Understory vegetation and stand structure. *In* Biology of alder, J. M. Trappe, . F. Franklin, R. F. Tarrant, and G. M. Hansen (eds.). Northwest Sci. Ass. Fortieth Annu. Meet. Symp. Proc. 1967: 37-43.

32. ______________ Dyrness, C. T., Moore, Duane G., and Tarrant, Robert F.
1968. Chemical soil properties under coastal Oregon stands of alders and conifers. *In* Biology of alder, J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen (eds.). Northwest Sci. Ass. Fortieth Annu. Meet. Symp. Proc. 1967: 157-172.

Organic matter, total nitrogen, and acidity were significantly greater in A horizons under alder and mixed stands. A horizons under conifer stands averaged three times richer in bases than those under alder stands. Similar differences, but of a much smaller magnitude, were observed in the B horizons. These effects may indicate greater production of acid decomposition products in the organic- and nitrogen-richer alder soils.

33. Franklin, Jerry Forest.
1966. Vegetation and soils in the subalpine forests of the southern Washington Cascade Range. Diss. Abstr. 27(6)B, 1746-B.

34. Fredriksen, R. L.
1963. Sedimentation after logging road construction in a small western Oregon watershed. Fed. Inter-Agency Sedimentation Conf. Proc. 1963. U.S. Dep. Agr. Misc. Pub. 970: 56-59, illus.

Suspended sediment in undisturbed watersheds follows a cyclic concentration pattern largely influenced by the precipitation and runoff pattern in western Oregon. Slides play an important but unpredictable role in geologic erosion.

35. ____________
1965. Christmas storm damage on the H. J. Andrews Experimental Forest. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-29, 11 pp., illus.

Three experimental watersheds in the western Cascades showed erosion from headwater streams occurring by mass movements during rain-snowmelt runoff periods. Erosion sequences in headwater streams and lower order streams are discussed.

36. Gessel, Stanley P., and Balci, A. Nihat.
1965. Amount and composition of forest floors under Washington coniferous forests. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 11-23, illus.

Differences in total depth and weight, humus layer type, weight loss-on-ignition, C:N ratio, chemical properties, and stage of decomposition are discussed for forest floors.

37. _______________ and Cole, Dale W.
1965. Influence of removal of forest cover on movement of water and associated elements through soil. J. Amer. Water Works Ass. 57: 1301-1310.

Clearcutting increases the rate of nitrogen release from the forest floor, particularly immediately after cutting. However, this increase in nitrogen movement did not reach a depth of 36 inches in the soil profile.

38. _______________ Cole, D. W., and Riekerk, H.
1966. Techniques and preliminary data of the movement of DDT and Zectran through a forest soil. Amer. Soc. Agron. Abstr., p. 94.

Neither DDT, applied to the forest floor at rates of 0.5 and 5.0 pounds per acre, nor Zectran, at 0.01 pound per acre, showed appreciable downward movement over a period of 1 year.

39. _______________ Stoate, T. N., and Turnbull, K. J.
1965. The growth behavior of Douglas-fir with nitrogenous fertilizer in western Washington - a first report. Univ. of Wash., Coll. of Forest. Res. Bull. No. 1, 204 pp., illus.

According to measurements of 238 field plots made to determine the effects of using fertilizer on growth of Douglas-fir, nitrogen is the one growth-stimulating nutrient element thus far noted.

40. Gehrke, F. E., and Steinbrenner, E. C.
1965. Soil survey methods used in mapping Weyerhaeuser Company forest lands in the Pacific Northwest. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 485-494, illus.

Weyerhaeuser Company has a detailed and accurate inventory of soils on 888,000 acres of its tree-farm lands for use in inventory, research, and forest management planning.

41. Gould, Marie L.
1965. Soil moisture investigations on grass- and shrub-land soils, 1942-1964; a bibliography. USDA Forest Serv. Pacific Northwest Forest & Range Exp. Sta., 5 pp.

42. Hallin, William E.
1967. Soil-moisture and temperature trends in cutover and adjacent old-growth Douglas-fir timber. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-56, 11 pp., illus.

Seasonal trends in soil moisture were compared for a timbered area and adjoining cutover area. Soil moisture on the cutover area was similar to that on the timbered area, indicating a nearly equal moisture drain by lesser vegetation on the cutover area.

43. ______________
1968. Soil surface temperatures on cutovers in southwest Oregon. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-78, 17 pp., illus.

Expected soil temperatures on various microsites and macrosites are presented, as well as recommendations for harvest techniques on steep southerly slopes.

44. Hermann, R. K.
1967. Paper mulch helps ponderosa pine seedlings get started on dry sites in Oregon. Tree Planters' Notes 18(4): 14-15.

Use of an asphalt-interlined paper mulch on 2-0 ponderosa pine seedlings significantly increased their rate of survival.

45. Hermann, Richard K.
1968. A watering experiment with sown ponderosa pine in central Oregon. Northwest Sci. 42: 47-52, illus.

46. Herring, H. G.
1968. Soil-moisture depletion by a central Washington lodgepole pine stand. Northwest Sci. 42: 1-4, illus.

Soil moisture under a lodgepole pine stand was measured at biweekly intervals throughout the growing season for 4 consecutive years. Data are presented on the summer soil moisture regime both before and after the trees were removed.

47. Hinds, W. T., and Rickard, W. H.
1968. Soil temperature near a desert steppe shrub. Northwest Sci. 42(1): 5-13, illus.

48. Hu, L., Youngberg, C. T., and Gilmour, C. M.
1968. Soluble carbon and respiration of forest humus. Amer. Soc. Agron. Abstr., p. 136.

Water soluble carbon determinations were shown to serve as a good index of stage of decomposition and humification of forest floor materials due to the positive correlation between water soluble carbon contents and respiration rates.

49. Klomp, G. J.
1968. The use of woodchips and nitrogen fertilizer in seeding scab ridges. J. Range Manage. 21: 31-36, illus.

Good initial stands of a timothy, hard fescue, and pubescent wheatgrass mixture were obtained from use of woodchips and nitrogen on scab ridges of northeastern Oregon.

50. Knox, E. G., Corliss, J. F., and Williams, J. M.
1965. Dark colored, acid, forest soils of western Oregon. Soil Sci. Soc. Amer. Proc. 29: 732-736, illus.

Describes properties of well-drained, strongly leached, relatively dark-colored soils of the most humid, forested areas of western Oregon and Washington. These soils are Haplumbrepts according to the 7th Approximation.

51. Kubota, Joe, Simonson, Victor A., and Hill, W. W.
1967. The relationship of soils to molybdenum toxicity in grazing animals in Oregon. Soil Sci. Soc. Amer. Proc. 31: 667-671, illus.

Molybdenum toxicity in ruminant animals has been traced to a soil-related nutritional problem.

52. Kuhlman, E. George.
1964. Survival and pathogenicity of *Phytophthora cinnamomi* in several western Oregon soils. Forest Sci. 10: 151-158.

When moisture is adequate, soil temperature is the critical factor regulating infection of forest trees by *P. cinnamomi* in the Pacific Northwest.

53. LaRock, R. G., and Cole, D. W.
1966. Soil moisture content, flow, tension, and hysteresis in a coarse glacial soil. Amer. Soc. Agron. Abstr., p. 97.

Soil moisture characteristics of a glacial outwash soil were evaluated during periods of soil moisture flow.

54. Li, C. Y., Lu, K. C., Trappe, J. M., and Bollen, W. B.
1967. Effect of pH and temperature on growth of *Poria weirii* in vitro. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-66, 6 pp., illus.

Growth of an isolate, tested on synthetic media ranging from pH 3.0 to 7.5, increased with pH to an optimum at 6.0. No growth occurred at 6.5 or higher. Growth also increased with temperature from 5° C. to 20° C., above which it decreased to none at 30° or higher.

55. ________ Lu, K. C., Trappe, J. M., and Bollen, W. B.
1967. Selective nitrogen assimilation by *Poria weirii*. Nature (London) 213(5078): 814.

This root-rotting fungus cannot assimilate the nitrate form of nitrogen, whereas soil organisms that inhibit *P. weirii* can. A buildup of soil nitrogen, such as occurs from nitrogen fixing by alder nodules, offers potential biological control of the disease.

56. Lopushinsky, William.
1966. Transpiration of conifer seedlings in relation to soil moisture stress. (Abstr.) Plant Physiol. Proc. Annu. Meet. 1966, p. iv.

Transpiration rates of potted ponderosa pine, lodgepole pine, Douglas-fir, grand fir, Engelmann spruce, and western larch seedlings were compared at various levels of soil moisture stress under controlled environmental conditions. Studies of stomatal sensitivity to leaf moisture stress were also made on twigs of each of these species.

57. Lu, K. C.
1968. Effect of organic amendments on soil microflora in relation to fusarium root rot of ponderosa pine seedlings. West. Forest. Conserv. Ass., West. Forest Nursery Counc. Proc. 1968: 40-45, illus.

Microbial populations in all amended plots were significantly higher than those of the control plot, possibly accounting for the reduction in disease associated with amendment.

58. ________ Chen, C. S., and Bollen, W. B.
1968. Comparison of microbial populations between red alder and conifer soils. *In* Biology of alder, J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen (eds.). Northwest Sci. Ass. Fortieth Annu. Meet. Symp. Proc. 1967: 173-178, illus.

All organisms were generally more numerous in the F layer than in the A_{11} horizon. Populations of molds were lowest in spring, when the soil was extremely wet. In the F layer, *Streptomyces* species, possible antagonists of root pathogens, consistently comprised a higher proportion of the total bacterial population of the mixed stand than of either pure alder or pure conifer stands.

59. Mayland, H. F.
1968. Measuring and interpreting rangeland soil fertility. Amer. Soc. Agron. Abstr., p. 137.

Fertility and potential yield increase indexes were determined for 119 semiarid rangeland soils of southeastern Oregon.

60. McCall, J. G., and Cole, D. W.
1968. A mechanism of cation transport in a forest soil. Northwest Sci. 42: 134-140.

Discusses the mechanisms that play a significant role in the transport and leaching of cations in a forest soil.

61. Miner, Norman H.
1968. Natural filtering of suspended soil by a stream at low flow. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-88, 4 pp., illus.

The "filtering" action occurring in a stream after soil is added by road construction is a combination of settling of larger particles and dilution of sediment-laden water.

62. Neal, J. L., Jr., Bollen, W. B., and Lu, K. C.
1965. Influence of particle size on decomposition of red alder and Douglas-fir sawdust in soil. Nature (London) 205: 991-993, illus.

Influence of sawdust added to soil on microbial activity depends on particle size: the smaller the particle, the faster its oxidation. This relationship may be due to the smaller particle's larger surface area in

relation to volume and the greater rupturing of lignin-cellulose bonds during their mechanical preparation. Addition of ammonium nitrate to sawdust did not stimulate oxygen uptake of samples, perhaps because the addition relieved microbes from the necessity of decomposing nitrogenous organic matter to meet their nitrogen requirements.

63. ______________ Bollen, W. B., and Zak, B.
1964. Rhizosphere microflora associated with mycorrhizae of Douglas-fir. Can. J. Microbiol. 10: 259-265, illus.

Rhizosphere populations of mycorrhizal roots differed according to morphological and physiological types and in total numbers compared with suberized root rhizosphere, nonrhizosphere microflora, and kind of mycorrhizal fungi.

64. ______________ Lu, K. C., Bollen, W. B., and Trappe, J. M.
1966. Two simple time-saving techniques for studies of soil microbial populations and subsequent culture characterization. Int. Soc. Soil Sci. Comm. III News Bull. 6: 38.

Through use of these low-cost materials and two simple techniques, microbial populations can be estimated and colonies isolated with substantial savings in time.

65. ______________ Lu, K. C., Bollen, W. B., and Trappe, J. M.
1967. Two simple, time-saving techniques for studies of soil microorganisms. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-57, 3 pp., illus.

Methods are described for uniform inoculation of an agar surface in a petri plate with a diluted soil suspension and for transfer of resulting colonies to sterile, broth-containing culture tubes.

66. ______________ Lu, K. C., Bollen, W. B., and Trappe, J. M.
1968. A comparison of rhizosphere microfloras associated with mycorrhizae of red alder and Douglas-fir. *In* Biology of alder, J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen (eds.). Northwest Sci. Ass. Fortieth Annu. Meet. Symp. Proc. 1967: 57-71, illus.

Microbial populations and ammonifying and nitrate-reducing microbes differed quantitatively and qualitatively between two microhabitats. Respiration of nonrhizosphere microbes was stimulated by Douglas-fir nonmycorrhizal root and red alder mycorrhizal root suspensions. Apparently an inhibitory substance in Douglas-fir mycorrhizal roots and red alder nonmycorrhizal roots suppressed glucose oxidation.

67. ______________ Lu, K. C., Trappe, J. M., and Bollen, W. B.
1966. Rhizosphere microbial activity of mycorrhizal and nonmycorrhizal roots of Douglas-fir and red alder. (Abstr.) Amer. Soc. Microbiol. Bacteriol. Proc. 1966, 2, A10.

Micro-organisms were more abundant on root surfaces of alder than of Douglas-fir. Different kinds of mycorrhizae varied in surface populations as well. Such differences may strongly influence the susceptibility of roots to attack by disease fungi.

68. Neal, John L., Wright, Ernest, and Bollen, Walter B.
1965. Burning Douglas-fir slash: physical, chemical, and microbial effects in the soil. Oreg. State Univ., Forest Res. Lab. Res. Pap. 1, 32 pp.

Initial effects of slash burning on physico-chemical and microbiological properties of soil appeared beneficial to soil fertility, but over a period of 1 year apparently lessened in desirability.

69. Norris, Logan A.
1968. Recovery of amitrole from forest litter. *In* Research progress report. West. Soc. Weed Sci., pp. 31-32.

The amount of amitrole herbicide recoverable from forest floor material decreases rapidly the first 5 days after the chemical is applied. Such loss may be due to chemical degradation, complexing with metal ions, adsorption, or any combination of these three actions.

70. Orr, Thomas J.
1965. Some uses, abuses, and potential uses of the soil-vegetation concept. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 495-501.

The soil-vegetation survey is a beginning point for ecological studies, rather than an ultimate answer.

71. Parsons, R. B., and Balster, C. A.
1966. Morphology and genesis of six "Red Hill" soils in the Oregon Coast Range. Soil Sci. Soc. Amer. Proc. 30: 90-93, illus.

Distribution of six soils on a basalt landscape is attributed to the slope gradients of several geomorphic surfaces. Textural discontinuities and soil chemical data are shown to be related to the geomorphology of the area.

72. Poulton, C. E.
1959. Soil-vegetation research and surveys in multiple-use management of western ranges. *In* Amer. Ass. Advance. Sci., Grasslands Proc., pp. 359-370.

73. Radwan, M. A.
1965. Persistence and effect of TMTD on soil respiration and nitrification in two nursery soils. Forest Sci. 11: 152-159, illus.

The persistence of tetramethylthiuram disulfide and some of its effects in the soil are examined with relation to its use as a repellent in forest tree nurseries.

74. Reukema, Donald L.
1964. Litter fall in a young Douglas-fir stand as influenced by thinning. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-14, 8 pp., illus.

A 13-year record from a young Douglas-fir stand illustrates the effect on amount and timing of litterfall by thinning treatments and climatic variations.

75. ________
1968. Growth response of 35-year-old, site V Douglas-fir to nitrogen fertilizer. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Note PNW-86, 9 pp., illus.

During the first 4 years following application, addition of 200 to 600 pounds of nitrogen per acre increased tree growth substantially. However, because heavier applications also increased amount of snowbreakage, net production tended to be greatest with the addition of 200 pounds per acre.

76. Riekerk, H.
1968. The mobility of phosphorus, potassium, and calcium in a forest soil. Amer. Soc. Agron. Abstr., p. 138.

Results of a study indicate that nutrient mobility is dependent on the ionic properties and biological functions of the elements, as well as the chemical and hydrothermal properties of forest soil components.

77. ________ and Gessel, S. P.
1965. Mineral cycling in a Douglas-fir forest. Health Phys. (Oxford) 11: 1363-1369, illus.

In a 40-year stand of Douglas-fir on gravelly, sandy loam the forest floor was treated with P^{32}, Rb^{86}, and Ca^{45}. Observations with tension lysimeters indicated a significant leaching of P^{32}.

78. ________ and Gessel, S. P.
1968. The movement of DDT in forest soil solutions. Soil Sci. Soc. Amer. Proc. 32: 595-596.

Periodic leachate collections from tension lysimeters placed under the forest floor and surface soil upon which DDT had been sprayed were analyzed. The sensitivity of the measurement techniques is demonstrated by the trace levels of DDT detected.

79. Rothacher, J., Dyrness, C. T., and Fredriksen, R. L.
1967. Hydrologic and related characteristics of three small watersheds in the Oregon Cascades. USDA Forest Serv. Pacific Northwest Forest & Range Exp. Sta., 54 pp., illus.

Trapezoidal flumes and other instrumentation were used to gather data preliminary to a study of the effect of timber harvesting and road construction on yield, timing, and quality of streamflow from three tributary watersheds in the McKenzie drainage of western Oregon. During the calibration period when the dense Douglas-fir forests remained undisturbed, data were collected which described the relationship of geology, soils, vegetation, and climate to streamflow.

80. Russel, Sterling A., and Evans, Harold J.
1966. The nitrogen fixing capacity of *Ceanothus velutinus*. Forest Sci. 12: 164-169, illus.

The efficiency of N fixation and the amount of N fixed per growth season for *Ceanothus velutinus* were found to be of the same order of magnitude as that reported for several legumes and nonleguminus symbionts.

81. Sauerwein, William J.
1965. Developing soil survey interpretations with a large forest landowner. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 441-455, illus.

Illustrates the development of soil-woodland interpretations from soil surveys of a 50,000-acre private forest.

82. Steen, Virginia C., and Fryxell, Roald.
1965. Mazama and Glacier Peak pumice glass: uniformity of refractive index after weathering. Science 150(3698): 878-880, illus.

Weathering has had little differential effect on modal values of the index of refraction of pumice glasses from the eruptions of Mount Mazama and Glacier Peak thousands of years ago. Confidence is thus increased that the ranges of values are reliable for distinguishing the two glasses.

83. Steinbrenner, E. C.
1965. The influence of individual soil and physiographic factors on the site index of Douglas-fir in western Washington. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 261-277, illus.

Soil and physiographic factors having either a positive or negative effect on growth of Douglas-fir are indicated.

84. ________________ and Rediske, J. H.
1964. Growth of ponderosa pine and Douglas-fir in a controlled environment. Weyerhaeuser Co., Forest. Pap. 1, 31 pp., illus.

This study assesses the growth response of ponderosa pine and Douglas-fir seedlings to controlled high and low levels of soil moisture, nitrogen, root temperature, air temperature, relative humidity, and light.

85. Stephens, F. R.
1965. Ponderosa pine thrives on wet soils in southwestern Oregon. J. Forest. 63(2): 122-123, illus.

In the South Umpquá drainage, growth of ponderosa pine on imperfectly drained soils is better than that of associated Douglas-fir and sugar pine. Ponderosa pine does not grow here on shallow, stony soils, although Douglas-fir, sugar pine, and other conifers form commercial stands.

86. ____________
1965. Relation of Douglas-fir productivity to some zonal soils in the Northwestern Cascades of Oregon. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 245-260, illus.

Despite a wide range in physiography and productivity, the soil series taxonomic unit is considered to predict Douglas-fir site index accurately on soils mapped in six well-drained zonal soils of the Oregon Cascades.

87. ____________
1966. Lodgepole pine--soil relations in the Northwest Oregon Cascade Mountains. J. Forest. 64: 184-186, illus.

In the study area, lodgepole pine grows only on well and excessively well drained, moderately coarse- and coarse-textured soils; and on poorly and very poorly drained organic soils.

88. Strand, R. F., and Austin, R. C.
1966. Evaluating fertilizer and other materials to speed growth of planted Douglas-fir. J. Forest. 64: 739-744, illus.

Several fertilizers, including magnesium ammonium phosphate, coated diammonium phosphate, and Torula yeast, are compared with two forms of urea with respect to release of nitrogen and increase of seedling growth.

89. Strickler, Gerald S.
1966. Soil and vegetation on the Starkey Experimental Forest and Range. Soc. Amer. Forest. Proc. 1965: 27-30.

Three forest and six grassland soil series are described and the vegetation characteristics of each discussed. Application to range research and management programs is given.

90. Tarrant, R. F.
1968. Forest soil improvement through growing red alder (*Alnus rubra* Bong.) in Pacific Northwestern United States. Eighth Int. Congr. Soil Sci. Trans., Bucharest, 1964. V: 1029-1043.

Compared with other species of *Alnus* studied throughout the Northern Hemisphere, red alder is at least equally effective in improving soil fertility and growth of associated trees. Silvicultural application of soil-improving and tree-growth-promoting qualities of red alder is considered feasible and desirable.

91. ____________ Lu, K. C., Bollen, W. B., and Chen, C. S.
1967. Chemical composition of throughfall and stemflow in three coastal Oregon forest types. Amer. Soc. Agron. Abstr., p. 137.

92. ____________ Lu, K. C., Bollen, W. B., and Chen, C. S.
1968. Nutrient cycling by throughfall and stemflow precipitation in three coastal Oregon forest types. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Pap. PNW-54, 7 pp.

Throughfall and stemflow were collected beneath three adjacent forest types--red alder, conifer (Douglas-fir, western hemlock, and Sitka spruce), and a mixture of alder and conifer. Weight of N and dissolved solids in stemflow was insignificant because of small amounts of stemflow and soil area affected. Nutrient cycling rates differ appreciably among the three forest types.

93. ____________ Lu, K. C., Bollen, W. B., and Franklin, J. F.
1968. Nitrogen enrichment of two forest ecosystems by red alder. Amer. Soc. Agron. Abstr., p. 139.

In pure stands or as an admixture with conifers, red alder has about a threefold increase in the amount of N circulating in litterfall and precipitation.

94. ____________ and Silen, Roy R.
1966. Growth and nutrient uptake of irrigated young ponderosa pine after fertilizer treatments. Soil Sci. Soc. Amer. Proc. 30: 796-799, illus.

Growth of irrigated ponderosa pine increased as amount of nitrogen fertilizer was increased. Phosphorus fertilizer in combination with nitrogen either increased or decreased growth depending on rates used. Unfertilized but irrigated trees grew much faster than unirrigated trees nearby.

95. Trappe, James M.
1965. Tuberculate mycorrhizae of Douglas-fir. Forest Sci. 11: 27-32, illus.

Describes formation and method of spreading in soil of a mycorrhiza, formed by two fungi in combination, which commonly occurs on Douglas-fir in the western coastal states and British Columbia.

96. Turner, D. O.
1966. Effect of fertilizer application on the color and growth of Douglas-fir Christmas trees. West. Soc. Soil Sci. Abstr. 1966: p. 21.

Describes effects on color, growth, and cone production of applying N, P, K, S, and Mg to chlorotic 15-year-old trees.

97. Turner, Darrell O.
1966. Color and growth of Douglas-fir Christmas trees as affected by fertilizer application. Soil Sci. Soc. Amer. Proc. 30: 792-795.

Improved foliage color, with no effect on growth during the first season, was demonstrated with the proper timing of nitrogen applications. Foliage color was correlated to needle nitrogen concentration, thus making possible the use of foliar analyses for scheduled fertilizer treatments.

98. ____________ and Gould, C. J.
1967. Influence of fertilizer treatment on growth and disease escape of salal (*Gaultheria shallon*). Amer. Soc. Agron. Abstr., p. 137.

Use of nitrogen fertilization on salal accelerated growth rates, which in turn brought plant development ahead of the peak period of fungi sporulation.

99. Webster, S. R., Youngberg, C. T., and Wollum, A. G., II.
1967. Fixation of nitrogen by bitterbrush (*Purshia tridentata* (Pursh) DC.). Nature (London) 216(5113): 392-393, illus.

Results of a study imply that bitterbrush makes a significant contribution to the nitrogen economy of the ecosystem in which it occurs.

100. Williams, Carroll B., Jr., and Dyrness, C. T.
1967. Some characteristics of forest floors and soils under true fir-hemlock stands in the Cascade Range. Pacific Northwest Forest & Range Exp. Sta. USDA Forest Serv. Res. Pap. PNW-37, 19 pp., illus.

Forest floors under 46 true fir-hemlock stands are discussed, using such characteristics as depth and weight of forest floor material, humus type, and amounts of available plant nutrients in the forest floor.

101. Wilson, A. M., Harris, G. A., and Gates, D. H.
1966. Fertilization of mixed cheatgrass-bluebunch wheatgrass stands. J. Range Manage. 19: 134-137.

Range sites having dense bluebunch wheatgrass and sparse cheatgrass or sparse bluebunch wheatgrass and dense cheatgrass were fertilized with increasing amounts of ammonium sulfate. Rather than improving range, heavy fertilization (80 pounds N per acre in 4 consecutive years) produced a retrogression in range condition: bluebunch wheatgrass yields decreased 50 percent and cheatgrass increased 400 to 600 percent.

102. Witty, John E., and Knox, Ellis G.
1964. Grass opal in some chestnut and forested soils in North Central Oregon. Soil Sci. Soc. Amer. Proc. 28: 685-688, illus.

The practicality of using grass opal as an indicator of the vegetative history of soils was investigated in a forest-grassland transition.

103. Wollum, A. G., II.
1966. Effects of soil temperature and light intensity on snowbrush. Amer. Soc. Agron. Abstr., p. 97.

Ceanothus velutinus was germinated and grown under several soil temperatures and light intensities. Optimum nodulation occurred between 20° and 25° C., and the results suggest that photosynthesis is required.

104. ____________ and Youngberg, C. T.
1964. The influence of nitrogen fixation by nonleguminous woody plants on the growth of pine seedlings. J. Forest. 62(5): 316-321, illus.

Snowbrush and red alder seedlings fixed nitrogen which became available for growth of Monterey pine seedlings within a limited mass of low-nitrogen soil. Amount of nitrogen fixed by snowbrush was about twice that provided by red alder.

105. ____________ Youngberg, C. T., and Gilmour, C. M.
1966. Characterization of a *Streptomyces* sp. isolated from root nodules of *Ceanothus velutinus* Dougl. Soil Sci. Soc. Amer. Proc. 30(4): 463-467, illus.

A total of 136 similar *Streptomyces* spp. were isolated from nodules of *Ceanothus velutinus*. Characterization by standard bacteriological procedures suggested that the isolates belonged to a single species, which did not correspond to any previously recognized *Streptomyces* sp.

106. Wooldridge, David D.
1964. Effects of parent material and vegetation on properties related to soil erosion in central Washington. Soil Sci. Soc. Amer. Proc. 28: 430-432.

Soil properties are influenced directly by parent material type and horizon development and indirectly by forest and grass vegetation. Soil erosion hazard is apparently related to soil organic matter, pH, total soil porosity, and bulk density.

107. ______________
1965. Soil properties related to erosion of wild-land soils in central Washington. *In* Forest-soil relationships in North America. Second N. Amer. Forest Soils Conf. Proc. 1963: 141-152, illus.

Describes a two-phase investigation of the relationship of soil properties to an index of soil erosion, mean aggregate size.

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1965. Tracing soil particle movement with Fe^{59}. Soil Sci. Soc. Amer. Proc. 29: 469-472, illus.

Rates and patterns of actual soil particle movement were established by measuring changes in radiation intensity with time on an eroding sandstone soil.

109. Wooldridge, David D.
1967. Water transport in soils and streams. *In* Transport phenomena in atmospheric and ecological systems. Amer. Soc. Mech. Eng. Proc. 1967: 3-20, illus.

Theory and concepts of moisture retention and flow in soils are reviewed and related to soil properties and subsequent contributions to streamflow. Water in streams is discussed in relation to climate, and forested areas as a source of streamflow are emphasized.

110. ______________
1968. An air pycnometer for forest and range soils. USDA Forest Serv. Pacific Northwest Forest & Range Exp. Sta., 11 pp., illus.

The calibration and use of an air pycnometer for accurately assessing porosity of forest and range soils are described.

111. ______________
1968. Forest floor and surface soils properties in central Washington. Amer. Soc. Agron. Abstr., p. 140.

Organic matter, pH, and exchangeable and total chemical analyses are presented for the L, F, and H layers of the forest floor and the soil A_1 horizon from a number of locations.

112. ________________ and Gessel, S. P.
1966. Forests and the Nation's water. Amer. Water Resources Ass., Water Resources Bull. 2: 7-12.

Forest lands are the source of three-quarters of the Nation's total usable streamflow. Increasing demands for use of forested acres for many forms of outdoor recreation and increasing demands for the forest's raw materials pose varied problems to resource managers. Activities on forest lands can alter the quality and quantity of water yielded.

113. Youngberg, C. T.
1966. Forest floors in Douglas-fir forests. I. Dry weight and chemical properties. Soil Sci. Soc. Amer. Proc. 30: 406-409.

Douglas-fir stands having different types of understory vegetation had dry weight and volatile matter of forest floors ranging from 20,000 to 76,000 pounds per acre and from 69 to 86 percent. Total N ranged from 0.71 to 1.52 percent. Values for other elements, exchangeable cations, and cation-exchange capacities are given.

114. ______________
1968. Effects of fertilization and thinning on the growth of ponderosa pine. Amer. Soc. Agron. Abstr., p. 140.

Growth was found to be 90 percent greater after thinning and 160 percent greater after thinning and fertilization than in the untreated stand.

115. _____________ and Dyrness, C. T.
1965. Biological assay of pumice soil fertility. Soil Sci. Soc. Amer. Proc. 29: 182-187, illus.

The fertility of pumice soils is difficult to assess by laboratory analysis. A biological assay of growth responses, utilizing a composite experimental design with ponderosa pine as indicator species, yields more meaningful information.

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1956. The effect of application of artificial fertilizer on height, radial, and branch growth of 35-year-old Douglas-fir. Univ. Wash.

117. Alban, David Henry.
1967. The influence of western hemlock and western redcedar on soil properties. Wash. State Univ.

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1962. The effects of nursery fertilization on the growth of Douglas-fir. Univ. Wash.

119. André, Johnnie Edgar.
1957. Effect of thinning Douglas-fir on soil moisture, temperature, and nitrogen relations. Oreg. State Univ.

120. Appleby, Arnold Pierce.
1962. The influence of soil temperature and soil placement on the phytotoxic properties of EPTC and other carbamate herbicides. Oreg. State Univ.

121. Arima, Tsuneo.
1965. Effect of stimulated growth by fertilization and thinning upon fibril angle and chemical composition of young Douglas-fir. Univ. Wash.

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1956. A practical analysis of soils engineering problems in the Douglas-fir region, with special emphasis on road construction. Univ. Wash.

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1967. The effect of soil moisture suction and soil temperature on transpiration, photosynthesis and respiration in Monterey pine (*Pinus radiata* D. Don). Oreg. State Univ.

124. Bailey, Edward Earl.
1959. Some economic aspects of forest fertilization. Univ. Wash.

125. Balci, Ali Nihat.
1963. Physical, chemical, and hydrological properties of certain western Washington forest floor types. Univ. Wash.

126. Ballard, Timothy Mangan.
1963. Some chemical changes accompanying soil development at the Kautz Creek mudflows, Mount Rainier National Park. Univ. Wash.

127. ______________
1968. Carbon dioxide production and diffusion in forest floor material--a study of gas exchange in biologically active porous media. Univ. Wash.

128. Banta, David Gareld.
1961. The practical application of soil engineering to forest road development. Univ. Wash.

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1965. A description of nitrogen and phosphorus distribution in some Rongelap Atoll land ecosystems. Univ. Wash.

130. Boardman, Robert.
1958. An ecological description of the Fern Lake Watershed. Univ. Wash.

131. Brackett, Michael Howard.
1965. Patterns of elemental distribution and response of Douglas-fir foliage to nitrogen fertilizer. Univ. Wash.

132. Brown, Robert Gordon.
1963. The effect of thinning, fertilization, and irrigation on the radial growth of a thirty-five year old Douglas-fir stand. Univ. Wash.

133. Chen, Hsien-fang.
1955. Growth and mineral uptake of Sitka spruce (*Picea sitchensis*) in solution cultures. Univ. Wash.

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1956. Effects of peat additions and seedling density upon development and chemical composition of Douglas fir (*Pseudotsuga menziesii*) nursery stock. Univ. Wash.

135. Chichester, Frederick Wesley.
1967. Clay mineralogy and related chemical properties of soils formed on Mazama pumice. Oreg. State Univ.

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1963. First year development of three conifers on surface and exposed subsoil horizons. Oreg. State Univ.

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1966. Heat and moisture transfer in pumice soil. Oreg. State Univ.

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1963. Release of elements from the forest floor and migration through associated soil profiles (a lysimeter study). Univ. Wash.

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1956. A method of forest soil site quality investigation. Oreg. State Univ.

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1962. Characteristics of some vegetation soil units in the juniper zone in central Oregon. Oreg. State Univ.

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1963. Seasonal effects of photoperiod and soil temperature on root initiation and elongation in Douglas-fir seedlings. Univ. Wash.

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1956. The effect of logging and slash burning on certain physical properties of forest soils. Oreg. State Univ.

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1960. Soil-vegetation relationships within the ponderosa pine type in the central Oregon pumice region. Oreg. State Univ.

145. Forbes, Robert Hall.
1945. The use of sand and water cultures in Douglas fir nursery practice. Oreg. State Univ.

146. Fredriksen, Richard Lee.
1962. The annual moisture cycle of two western Washington soils. Univ. Wash.

147. Frehner, Hans K.
1957. Development of soil and vegetation on the Kautz Creek flood deposit in Mount Rainier National Park. Univ. Wash.

148. Gallagher, Leonard Ultan.
1963. A study on the effects of fertilization with nitrogen and potassium on the growth and nutrition of *Abies amabilis* with associated greenhouse trials. Univ. Wash.

149. Garay, Sandoval Lorenzo.
1967. Relations between soil characteristics and plantation growth of Monterrey pine in the Concepcion Zone, Chile. Univ. Wash.

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1950. The use of plants as site indicators for Douglas fir in Coos County, Oregon, and the correlation of site with soil properties. Univ. Wash.

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1967. Vegetation-soil relations as a basis for resource management on the Ochoco National Forest of central Oregon. Oreg. State Univ.

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1962. Thinning, fertilization and irrigation effects on growth of 30-year-old Douglas-fir stand. Univ. Wash.

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1961. Effects of nitrogen fertilization on the growth and nitrogen nutrition of low-site Douglas-fir stands. Univ. Wash.

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1960. The influence of seedbed micro-environments upon the establishment of Douglas-fir. Oreg. State Univ.

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1969. Soluble carbon and respiration of forest humus. Oreg. State Univ.

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1967. Red alder deficiency symptoms and fertilizer trials. Univ. Wash.

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1952. Correlation of ponderosa pine site quality and certain soil properties on the Colville Indian Reservation, Washington. Univ. Wash.

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1958. Soil properties related to vegetation and time on the Kautz Creek flood area, Mount Rainier, Washington. Univ. Wash.

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1957. Ecological aspects of the nitrogen nutrition of fireweed *(Epilobium angustifolium)* with reference to nitrification in several forest soils of the Douglas fir region. Univ. Wash.

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1968. Amount and chemical composition of understory vegetation in Alsea Basin forest communities. Oreg. State Univ.

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1965. A study of soil development on dated pumice deposits from Mount Mazama, Oregon. Univ. Calif.

185. Tidball, Ronald Richard.
1957. The effect of dry heat on available phosphorus in forest soils. Univ. Wash.

186. Tiedemann, Henry.
1934. The establishment of Douglas fir reproduction in relation to certain natural environment factors. Oreg. State Univ.

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1962. *Cenococcum graniforme*--its distribution, ecology, mycorrhiza formation, and inherent variation. Univ. Wash.

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1959. Soil-site relationships in second growth Douglas-fir stands in the central Oregon Coast Range. Oreg. State Univ.

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Headquarters for the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is in Portland, Oregon. The Station's mission is to provide the scientific knowledge, technology, and alternatives for management, use, and protection of forest, range, and related environments for present and future generations. The area of research encompasses Alaska, Washington, and Oregon, with some projects including California, Hawaii, the Western States, or the Nation. Project headquarters are at:

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The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.